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from his large work, and the volume is intended for school use and for those who cannot afford to buy his expensive history. There is no doubt of the accuracy of the data which the author adduces. It must be regretted, however, that he has not correlated geography and history. His book is a condensed compendium of historical fact, with only the most casual allusions to the geography of the region. As history is shaped, in an important degree, by geography, it would have vivified the narrative if the geography had been so far set forth as to supply a background for the history. The black-and-white map, reduced in size for the book, contains a very large amount of data, so compressed, however, that it is almost illegible. In the hands of a trained cartographer this map, rich in good material, would have been made most informing if it had been produced on a sufficiently large scale.

Precise Leveling from Brigham, Utah, to San Francisco, Cal.

By William Bowie. 67 pp. Maps, index. *U. S. Coast & Geod. Surv. Special Public. No. 22.* 1914. 11½ x 9.

The elevations of the bench marks resulting from the 1912 adjustment of the precise level net of the United States are considered standard. Instead of making a readjustment of the entire level net as new leveling accumulates, the new lines are to be adjusted or fitted in between standard bench marks of the existing net, or between mean sea level and a standard bench mark.

The line of precise levels between Brigham and San Francisco, reported in this publication, is the first to be added to the level net since its adjustment in 1912. It finely illustrates the accuracy of the standard elevations in the vicinity of the Pacific Coast. The line starts at sea level, determined from sixteen years of continuous tidal observations at San Francisco, and follows the route of the Southern Pacific Railroad to Brigham, Utah, where it ends on standard bench mark "R." The new leveling gives, for the elevation of bench mark "R," a value only 0.0179 meter higher than the standard elevation, as given in the level net.

The line is 891 miles in length and fixes the elevation of 315 permanent bench marks and of the rail in front of each of the railroad stations along the route. The standard elevations of the bench marks and of the rail are published in meters and feet. As in all precise leveling in the United States, the datum used is mean sea level.

A departure from recent practice is the publication of the complete abstract of the line. The California section of the line reveals a profile not commonly encountered. Except while crossing the low foothills of the Coast Range, the line west of Elvas, 278 kilometers from San Francisco along the rail route, has an average elevation of less than twenty meters. At Elvas the ascent of the Sierra Nevada Mountains is begun, and a height of 2134 meters is attained in only 159 kilometers, an average grade of about 1.3 per cent.

Included in the report are discussions of the methods and the accuracy attained in precise leveling.

On the leveling between San Francisco and Brigham the observer used a motor velocipede car to transport his party and instruments to and from his field work. This is the first time that a power car has been used in precise leveling.

A study of systematic errors of leveling was made. It was based upon the data for five lines, which include the times of the runnings of the different sections, the weather conditions prevailing and the difference between the forward and backward runnings. The largest systematic errors are found in leveling over steep grades, and the errors are functions of the time of day, the amount of sunshine, the strength of the wind and, possibly, the direction of the running, that is, toward or away from the sun. The author believes that most accurate results in leveling can be obtained in the afternoon, with an overcast sky and a light wind.

A valuable feature of the publication is the index maps at the end of the volume, which give the general location of the line of levels and of the bench marks.

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